Branch
BIODIVERSITY
SPATIAL PLANNING
CLIMATE CHANGE

Planning for biodiversity as climate changes

BRANCH project final report | English version

www.branchproject.org.uk

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BRANCH stands for **B**iodiversity **R**equires **A**daptation in **N**orth West Europe under a **CH**anging climate

Contents

This report should be referenced as: BRANCH partnership (2007), 'Planning for biodiversity in a changing climate – BRANCH project Final Report', Natural England, UK.

Spatial planners are key to providing opportunities for biodiversity to adapt to climate change. But in North West Europe, many of the current policies and planning systems will not meet this challenge. Action is needed now and it must happen at all scales, from the international to the local site level.

Summary

ABOVE LEFT: THE NATURAL ENVIRONMENT PROVIDES VITAL GOODS AND SERVICES TO SOCIETY, BUT IT IS FACING UNAVOIDABLE IMPACTS FROM CLIMATE CHANGE. IMAGESOFHOLLAND.COM

ABOVE MIDDLE: EUROPE NEEDS WILDLIFE NETWORKS THAT ALLOW SPECIES TO RESPOND DYNAMICALLY TO CLIMATE CHANGE. NASA IMAGES

ABOVE RIGHT: ACROSS EUROPE THERE ARE ALREADY SIGNS THAT WILDLIFE AND HUMAN LIVELIHOODS ARE BEING AFFECTED BY CLIMATE CHANGE. PYRAMIDAL ORCHID. NATURAL ENGLAND

BRANCH evidence confirms that there is an urgent need for spatial planners to act now to ensure that wildlife can respond to the impacts of climate change. This report summarises the project's research findings and recommends how current planning practices should be improved to incorporate adaptation to climate change.

BRANCH has shown that Europe's fragmented landscape is likely to prevent many species from moving with shifting favourable climate conditions into new areas. How well a species can adapt to climate change will depend largely on how easily it can disperse and whether suitable habitat is available to move through and into.

On land, each species will respond differently. The character of the landscape that plants and animals try to cross to establish new populations will be important. As will the size of suitable areas of habitat and how easy it is for species to move between them. Spatial planning can create networks of high-quality, well-connected habitats. Where this happens, BRANCH has shown that wildlife will be more resilient to climate change.

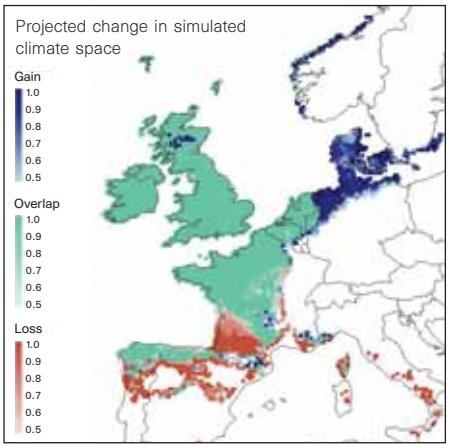
On our coasts, the space available for wildlife will shrink as sea-levels rise. In some places, habitats will disappear. In others, difficult decisions need to be made on prioritising space between internationally important habitats. Planners can provide space so that coastal habitats can move. But to be successful, they will need to work at a larger geographical scale, sometimes even across national boundaries.

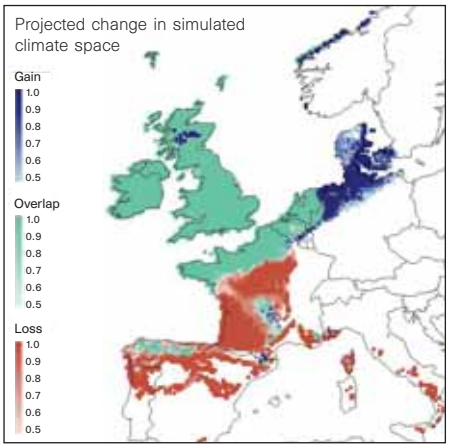
BRANCH argues that biodiversity policy must be integrated into other land use policies. Planning must use much longer timescales. Guidance must change to allow planning to be more flexible. Planners themselves need policies and new tools and BRANCH provides the foundation for these.

BELOW LEFT: EMBEDDING ACTIONS FOR WILDLIFE INTO SPATIAL PLANNING WILL HELP SAFEGUARD WILDLIFE'S NATURAL BENEFITS FOR FUTURE GENERATIONS. BLUEBELL WOODLAND (UK). NATURAL ENGLAND

BELOW MIDDLE AND RIGHT: SPECIES' MODEL PROJECTIONS OF POTENTIAL SUITABLE CLIMATE SPACE FOR BLUEBELL FOR 2050s, USING CLIMATE CHANGE SCENARIOS HADCM3A2 (BELOW MIDDLE) AND PCMA2 (BELOW RIGHT). ECI

Models and assumptions





Use of models

Researchers use computer models to simulate natural systems and to help them understand how they work. Global circulation or climate models (known as GCMs) are the only way to predict how the climate will change over a long timescale. Models of climate change are not perfect. The climate is complex and models cannot show all the different ways it could behave. But the scientific community believes that better models would come to the same conclusion: our climate is changing because of human influences.

The predictions of GCMs are used by some of the BRANCH simulation models, for example, the SPECIES model. This projects changes in distribution of suitable 'climate space' (the locations where climate conditions are favourable) for species.

BRANCH also used other models to simulate future changes: DIVA for coastal vulnerability; SMALLSTEPS and GRIDWALK for species' movement; LARCH for the sustainability of habitat networks; and CENA for the connectivity between wildlife sites.

Scenarios and assumptions

Researchers use different scenarios to explore how the climate will change under different assumptions. These assumptions might include the rate of growth in population or greenhouse gas emissions.

BRANCH used scenarios to show the different ways in which Europe's climate might change. These were based on the Parallel Climate Model, the Hadley Centre Model and up to four projections of global carbon emissions (low, medium low, medium high and high) produced by the Intergovernmental Panel on Climate Change. BRANCH looked at the effects of these scenarios in three time periods: the 2020s, 2050s and 2080s. See Annex 2 for further detailed scenarios.

Uncertainties

Predicting future climate through simulation modelling is inevitably uncertain. The climate system behaves chaotically. It is also unclear how external influences will affect the climate. Generally, the longer the timescale, the more uncertain the model projections will be. Modelling for small geographical areas, such as counties, is more uncertain than modelling for large areas, such as continents. Because of this, BRANCH has reported trends, rather than making site-specific statements. In discussing whether an impact is likely to occur, this report relies not just on computer projections but also on the views of experts.

Introduction

The BRANCH project

BRANCH aimed to show how spatial planning could help biodiversity adapt to climate change. It brought together planners, policy makers and scientists from England, France and the Netherlands. Partners shared experience and knowledge to produce practical recommendations, based on science. This report sets out what the project achieved and what should happen next.

The region

North West Europe is a built-up and economically powerful part of the world. The landscape is already fragmented and wildlife is under pressure. For many species, climate change will intensify this pressure.

Biodiversity and climate change

In the short-term, climate change is unavoidable. We are already seeing its effects on biodiversity. Along our coasts, wildlife is being constrained between rising sea levels and flood defences. On land, it is being forced to higher latitudes and altitudes by rising temperatures. Some habitats and species must find new places to establish themselves or they will disappear. This is a major challenge for Europe as it seeks to meet its target to "halt the loss of biodiversity by 2010" and beyond.

Biodiversity and people

People are dependent on nature. It sustains us and improves our quality of life. Some natural benefits, such as raw materials, are economically valuable. Others, like well-managed natural habitats, help us to cope better with the effects of flooding and pollution. Some benefits, like places for recreation, make us healthier. All these services provided by biodiversity are threatened by climate change.

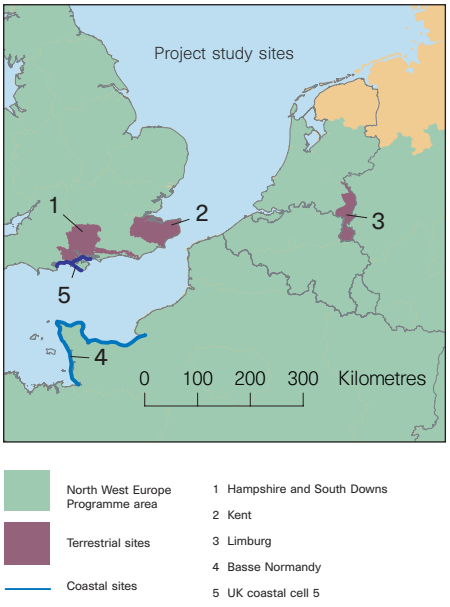
Critical role for planners

Planners can play a vital role in ensuring these natural benefits continue, despite climate change. Planners already have some mechanisms to help maintain and create landscapes that allow wildlife to adapt. But new policies are needed. This report provides guidance on how this should happen.

ABOVE: THE TIMINGS OF NATURAL EVENTS ARE CHANGING. LONG-TERM STUDIES HAVE SHOWN THAT TREES ARE COMING INTO LEAF EARLIER. HORSE-CHESTNUT BUD. MIKE HENCHMAN/NATURAL ENGLAND

MIDDLE: OUR COASTLINES PROVIDE WILDLIFE AND LANDSCAPES FOR PEOPLE TO ENJOY. CRT NORMANDY

RIGHT: BRANCH LOOKED AT THE POTENTIAL IMPACTS OF CLIMATE CHANGE ON OUR WILDLIFE, COUNTRYSIDE AND COASTS AT THE EUROPEAN TO LOCAL CASE STUDY LEVEL. NATURAL ENGLAND



A review by BRANCH shows that current interpretation and implementation of planning policies will not help wildlife adapt to climate change. Policies must be more flexible and integrated across sectors. They should use longer planning horizons and be based on clear guidance. National leadership is needed to encourage local implementation.

Planning for change

Review of planning polices

TOP: BRANCH HAS BROUGHT TOGETHER PLANNERS, POLICY MAKERS AND SCIENTISTS. NATURAL ENGLAND

ABOVE: TOOLS TO HELP PLANNERS INTEGRATE CLIMATE CHANGE ADAPTATION INTO POLICY ARE ALREADY AVAILABLE. INTERACTIVE MAPS OF BIRD SURVEYS. PROVINCIE LIMBURG

Reviewing current policy

BRANCH commissioned Oxford Brookes University to review the effectiveness of existing plans and policies relevant to climate change and biodiversity. The study examined spatial planning policies for coasts and inland areas, from European to local levels. Policy makers and planners were consulted at workshops in Winchester, The Hague and Brussels, with interviews in northern France. The study tested current planning measures at five case studies and a number of recommendations and opportunities emerged.

Advocacy

BRANCH used this work to refine the project's policy recommendations and tools for planners. We discussed the issues at national and international conferences and study tours. Our work with policy makers and planners culminated in a series of training events in England, France and the Netherlands. These events raised awareness of climate change and biodiversity amongst planners and were designed in a way which will allow other organisations to deliver them in other places.

Key findings

Policies

England, France and the Netherlands all recognise the need for plans to allow biodiversity, particularly on coasts, to respond to climate change. But policies on how climate change will affect biodiversity are at different stages in each country.

Planning has been slow to provide for adaptation to climate change because of: the low profile of biodiversity; uncertainties about the likely impact of climate change and how best to intervene; and no clear vision, strategy or programme of delivery.

Current policies and guidance are inflexible and inadequate. They do not go far enough to help biodiversity to adapt to climate change. However, some policies, if consistently and fully implemented, start to provide the framework for adaptation actions for biodiversity. These policies are likely to benefit biodiversity now and in the future.

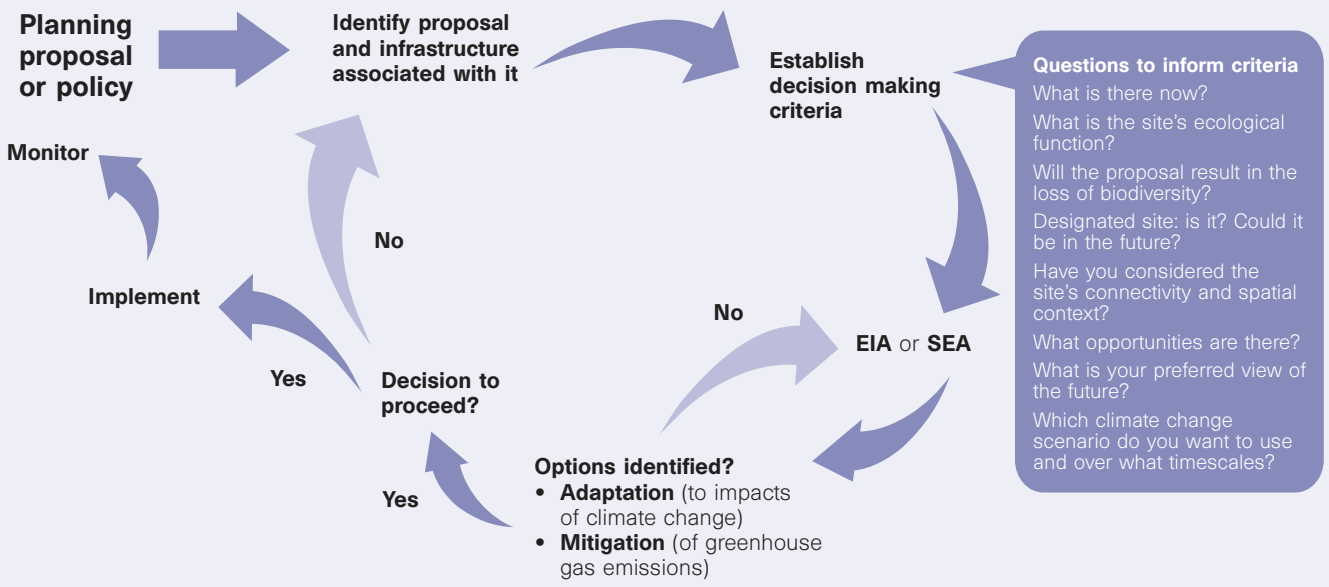
The barriers for planners

Planners told BRANCH why they were not taking more account of climate change and biodiversity. Their reasons included:

- Lack of clear leadership and allocated responsibility for biodiversity.
- Lack of capacity to implement change and safeguard future sites for biodiversity.
- Timescales for responding to climate change are longer than most planning timescales.
- Conflicting aims for land in the spatial plans for different sectors, for example, between biodiversity plans and infrastructure plans.
- Insufficient information, for example on the best places to safeguard or enhance for wildlife.

BRANCH HAS DEVELOPED A DECISION TESTING FRAMEWORK TO SUPPORT POLICY AND PLANNING DECISIONS FOR BIODIVERSITY IN THE FACE OF CLIMATE CHANGE. THIS IS BASED ON THE UK CLIMATE IMPACTS PROGRAMME'S DECISION TESTING TOOL. DURING POLICY OR PLAN PREPARATION, THE BRANCH RESULTS CAN BE USED TO IDENTIFY SPECIES AND HABITATS AT RISK FROM CLIMATE CHANGE. THE FRAMEWORK THEN ASKS A SET OF QUESTIONS TO IDENTIFY THE ADAPTATION MEASURES OR ACTIONS THAT ARE NEEDED, HELPING TO 'FUTURE-PROOF' PLANNING DECISIONS.

The BRANCH pathway



Recommendations

BRANCH argues that measures to help biodiversity adapt to climate change should be embedded in spatial planning. To make this happen, the following changes are needed:

- Longer spatial planning timescales that allow consideration of the long-term impacts of climate change over the next 50 to 100 years, in order to inform action now.
- A shared vision, strategy and action plan for changing biodiversity.
- Increased integration of different policy sectors, such as biodiversity, economic development, agriculture and water.
- Increased integration of plans across boundaries and at different geographical levels, from European to local.
- A planning system that permits a sequence of land use changes over time, favouring wildlife.
- Spatial planning that promotes a network of wildlife sites, connected through all forms of land use, to enable wildlife movement between them.
- A risk-management approach that takes into account climate change when making planning decisions, using tools such as Strategic Environmental Assessment of plans and Environmental Impact Assessment of projects.
- Legal and financial measures that promote the adaptation potential of biodiversity.
- Enforceable implementation of existing biodiversity policies.
- Wider recognition of the benefits of biodiversity to people and the economy.

New techniques developed by BRANCH have identified which species and regions of Europe are most vulnerable to climate change. They confirm that Europe's fragmented landscape is likely to prevent many species moving in the face of climate change. On coasts, saltmarsh and mudflats will continue to shrink as sea-levels rise, decreasing natural coastal protection.

The science of climate change

Results of BRANCH modelling

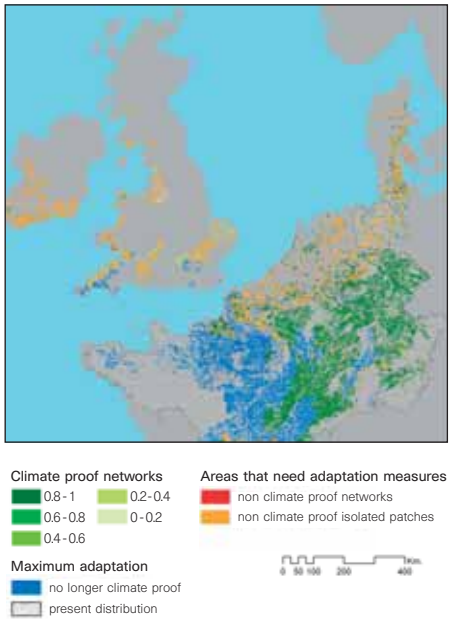
BRANCH developed transferable techniques at a European scale to identify coastal and terrestrial areas that are vulnerable to climate change. These techniques include developing "vulnerability indices" – simple quantitative measures of the sensitivity of species and habitats to climate change.

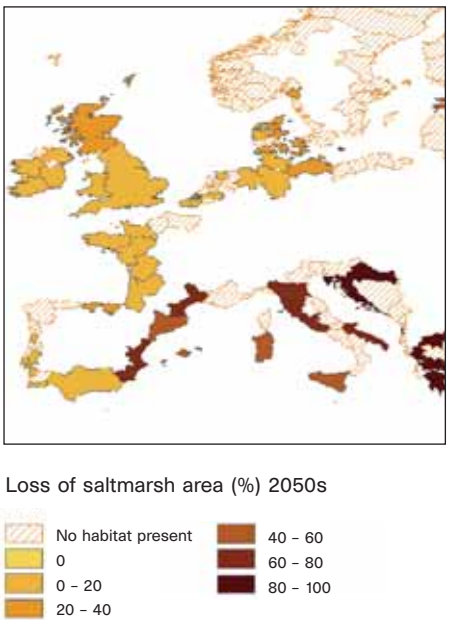
One partner, the Environmental Change Institute (University of Oxford), used the SPECIES model to project changes in potential suitable 'climate space' (the location where climate conditions are favourable) for 389 terrestrial and coastal species. Another partner, Alterra (Wageningen University and Research Centre), then used the GRIDWALK and CENA models to simulate how nine of these species, which are representative of forest, wetland or grassland ecosystems, might move across the landscape in the face of climate change. It also looked at how current habitat networks might enable this movement and where action may be needed to reduce barriers. For the coast, the University of Southampton used the DIVA model to assess how saltmarsh and mudflats will respond to rising sea levels. In partnership with the University of East Anglia, it devised a new index of coastal habitat vulnerability for North West Europe. This highlights areas where habitats are likely to face the greatest pressures and is a tool for sustainable coastal management.

BELOW LEFT: CENA ANALYSIS OF MIDDLE SPOTTED WOODPECKER FOR 2050S. GREEN AREAS FORM A CONNECTED NETWORK OF WOODLAND HABITAT FOR THIS SPECIES. THE DARKER THE SHADE OF GREEN, THE LARGER THE OVERLAP OF NETWORKS SUITABLE IN 2050S AND PREVIOUS CLIMATE SCENARIOS, AND THEREFORE, THE MORE RESILIENT TO CLIMATE CHANGE. ORANGE AND RED AREAS ARE A FOCUS TO TARGET ACTION TO PROMOTE CONNECTIVITY. BLUE AREAS ARE UNLIKELY TO BE CLIMATICALLY SUITABLE FOR THIS SPECIES. ALTERRA.

BELOW MIDDLE: MIDDLE SPOTTED WOODPECKER CAN BE FOUND NOW IN DECIDUOUS FOREST REGIONS IN MAINLAND EUROPE. RSBP-IMAGES.COM

BELOW RIGHT: A PROJECTION OF POTENTIAL LOSS OF SALTMARSH IN EUROPE FOR 2050s USING THE DIVA MODEL. MODEL OUTPUTS REPRESENT A QUANTITY PER UNIT AREA. TYNDALL CENTRE.





Key findings

Coastal habitats

Intertidal coastal habitats will decline everywhere in Europe if the policy of 'holding the line' of existing sea defences continues. The most vulnerable intertidal habitats are around the Black Sea, Mediterranean and the Baltic. Saltmarsh and mudflats on these coasts are likely to disappear as sea-levels rise, reducing their coastal protection functions. The threat to saltmarsh and mudflats throughout Europe will increase during this century, particularly under high emissions scenarios. The length of coastline in North West Europe that has a high vulnerability to sea-level rise is predicted to increase by 46% under the 2080s high emissions scenario. There is increasing interest in managed realignment across Europe, especially in northern Europe, offering opportunities for intertidal habitat creation.

Species

BRANCH results show that species become more vulnerable the greater the change in climate. By the 2080s, six of the 389 species modelled could lose all suitable climate space, and 11 could lose more than 90% whilst only 28 could double their suitable space.

Modelling nine species in more detail shows that they may not be able to move sufficiently in the face of climate change because habitat networks in North West Europe are too fragmented. In particular, the small and fragmented nature of wetland ecosystems increases the vulnerability of species, such as the bittern, that require large areas of suitable habitat. Even if locations develop suitable climate space, species with a small dispersal capacity and species that are sensitive to urban barriers, such as the pool frog, will be unable to colonize them. For all nine species, the amount of habitat that they could occupy in the Natura 2000 network of North West Europe's most important wildlife sites, is likely to fall between now and the 2050s.

Biogeographic regions

BRANCH looked at the likely impact of climate change on 6 of the 11 European biogeographic regions: the Alpine, Atlantic, Boreal, Continental, Mediterranean and Pannonian regions. In most of these, vascular plants, birds and amphibians could lose suitable climate space by the 2080s. The Mediterranean region is likely to be particularly vulnerable to losing existing species. The Boreal region in Scandinavia is the only region predicted to have a steady rise in the number of species by the 2080s. Many species in the Alpine and Atlantic regions are likely to maintain their current suitable climate space. But Alpine species may need to move to higher altitudes.

Recommendations

Europe as a whole

- Give greater recognition in EC Directives to the vulnerability of species to climate change.
- Identify and enhance the main zones that species may use to disperse between Natura 2000 sites, encouraging the development of an European ecological network.
- Maintain intertidal habitats, especially around the Mediterranean, Black and Baltic seas, by creating space for coasts to adapt.
- Compile consistent datasets for coastal habitats to improve strategic assessment and management of the coast.

North West Europe

- Reduce fragmentation by, for example, developing more wetlands and woodlands, and enlarging existing ones.
- Identify where new saltmarsh, mudflats and grazing marshes could be created.
- Co-operate across national borders to improve ecological networks in delta areas by combining nature conservation and flood management objectives.
- Develop climate-proof networks at the regional scale for sensitive species by creating conditions for dispersal and reducing the effect of barriers.

Past planning decisions and legislation are limiting the ways planners can help facilitate biodiversity adapting to rising sea levels. To develop opportunities for habitat conservation and re-creation planners need to take a regional scale approach.

Impacts, change and creation

An overview of BRANCH's work on coasts

BRANCH examined the impacts of sea-level rise on the coast at different geographical scales, from individual sites to entire stretches of coastline. Partners used a variety of climate change scenarios for the time periods from now to the 2080s.

A transferable methodology was developed using baseline habitat surveys and habitat modelling. This was used to assess the potential impact of sea-level rise on habitat distribution and the space available to individual species. Modelled outputs were then used to create computer visualisations of the sites affected by sea-level rise. These results were discussed in a series of events with spatial planners and other stakeholders to inform the development of adaptation tools and mechanisms.

ABOVE LEFT: VISUALISATIONS OF FUTURE CLIMATE SCENARIOS AT THE COAST HAVE BEEN USED TO ENGAGE STAKEHOLDERS. TYNDALL CENTRE

ABOVE RIGHT: SEA-PEA, FOUND ON COASTAL SHINGLE, COULD LOSE SUBSTANTIAL SUITABLE CLIMATE SPACE BY THE END OF THE CENTURY. NATURAL ENGLAND

LEFT: THE BAIE DU MONT SAINT-MICHEL WAS ONE OF SEVEN FRENCH CASE STUDY SITES. CRT NORMANDY

Key findings

Habitats and species

With predicted rises in sea level, the mix of coastal habitats at local sites in France and the UK will change in extent, location and species assemblages. Pressure on space at local sites could lead to difficult choices for planners between wildlife habitats and other land uses.

The beneficial coastal protection that some habitats provide may be reduced. For example, in the UK because saltmarsh dissipates wave energy, its loss will increase the pressure on coastal defence structures.

The mix of species that coastal ecosystems currently support will change, affecting the food sources that bird and mammal species rely on. In France, dune systems are being eroded but saltmarsh is currently expanding, reducing the area of mudflat for wading birds.

Planning and policy

Prioritising space for one designated habitat over another cannot be resolved on a site-by-site basis because planning options are often constrained by previous land use decisions. For example, managed realignment to replace the loss of intertidal habitats, often produces less saltmarsh than is widely assumed. Newly created areas are often too low-lying and not viable for saltmarsh re-creation. Such sites would require further soft engineering. Additionally, actions to replace the loss of intertidal habitats will affect other habitats, which may also be designated.

The opportunities for local or regional habitat re-creation are limited. Planners need to take a larger-scale approach and plan to replace habitats across regions, countries or even across Europe. This will require re-interpretation of key legislation, such as the EC Habitats Directive.

Recommendations

National action

- Develop a national planned response to sea-level rise in EU Member States to ensure decisions are taken at a broad geographical scale.
- Review the way the EC Habitats and Birds Directives are interpreted for coasts. It may be more appropriate to maintain stocks of designated habitat or use rolling boundaries to allow natural movement rather than protect static geographically defined areas.
- Further examine the close relationships between mudflats, saltmarsh, coastal grazing marsh and saline lagoons and the potential for their re-creation.

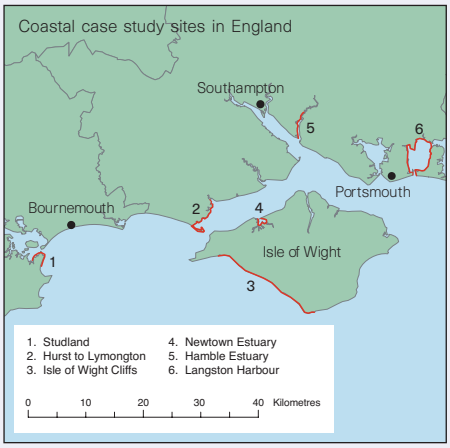
Regional and local action

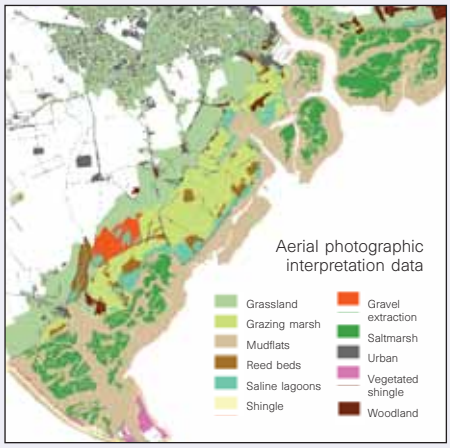
- Investigate alternative management techniques appropriate for coastal habitats such as soft engineering techniques to encourage saltmarsh growth.
- Create space to allow designated cliff-top habitats to retreat inland.
- Work with dynamic coastlines and plan space into the future for coasts to adapt to climate change. This may require the reserving of land suitable for habitat re-creation.
- Debate and resolve the issues surrounding the creation of sustainable grazing marsh within river floodplains to replace lost coastal grazing marsh.
- Carry out more long-term monitoring to help planning policy tackle the impacts of climate change, especially in areas with limited data.

Saltmarsh, sand dunes and shingle habitats are likely to decline on the UK's south coast as sea-levels rise. Engineering techniques and spatial planning may be able to re-create some of these habitats – but not necessarily in their current locations.

Options for adaptation

Case study – the UK South Coast





Coastal case studies in the UK are located along the south coast between Selsey Bill in West Sussex and Portland Bill in Dorset.

Habitats found on this part of the coast include: shingle beaches; sand dunes; saltmarsh and mudflats; coastal grazing marsh; saline lagoons; reed beds and natural maritime cliff and slope.

For all the sites, BRANCH assessed the habitat distributions and surrounding land use. Changes in the extent of intertidal habitat were modelled for the next 80 years, using variable rates of sea-level rise and different coastal management options. Analysis was then carried out at a regional scale to investigate options for habitat creation.

OPPOSITE TOP LEFT: LOCATIONS OF THE SIX CASE STUDY SITES ALONG ENGLAND'S SOUTH COAST. NATURAL ENGLAND

OPPOSITE TOP MIDDLE: AERIAL HABITAT SURVEYS WERE CARRIED OUT ALONG THE SOUTH COAST AND HABITAT CLASSIFICATIONS WERE VALIDATED ON THE GROUND. THESE DATA FORM THE BASELINE FOR MODELLING CHANGES TO HABITAT DISTRIBUTIONS UNDER CLIMATE CHANGE. HURST-LYMINGTON. TYNDALL CENTRE/ENVIRONMENT AGENCY

OPPOSITE TOP RIGHT: EXTENT OF INTERTIDAL HABITAT DISTRIBUTION AT HURST-LYMINGTON, MODELLED UNDER A MEDIUM-HIGH SEA-LEVEL RISE SCENARIO (35 CM) FOR 2050S. TYNDALL CENTRE

OPPOSITE LEFT: SALTMARSH AT LYMINGTON-KEYHAVEN CASE STUDY SITE. PETER WAKELY/NATURAL ENGLAND

Findings

The current loss of habitat in many intertidal areas will be exacerbated by a rise in sea level. Saltmarsh currently dissipates wave energy and, as a result of its loss, sea walls will need costly upgrades. Sand dunes and vegetated shingle have declined greatly and there is little scope for expansion or habitat creation. Cliff habitats are likely to be retained, although habitats will move landward beyond fixed designated boundaries.

It is often not feasible to replace habitats locally. The reduction in available space will inhibit the movement and adaptability of important habitats, particularly saltmarsh, mudflat and coastal grazing marsh. Difficult decisions will have to be made to prioritise between different designated habitats where there is limited space. Freshwater habitats may not be sustainable in coastal areas in the long-term and their relocation to more suitable areas should be considered.

Hurst Spit to Lymington Marshes case study

Hurst Spit (site 2) is a 2km long, artificially maintained, partially vegetated shingle barrier. It protects areas of saltmarsh and intertidal mudflats on its landward side. There are coastal grazing marshes and saline lagoons behind seawalls at Pennington in areas previously reclaimed from the sea.

These habitats are important for wildlife and biodiversity and the area is designated as a Ramsar site, Special Protection Area and a Site of Special Scientific Interest. Additionally, the intertidal areas are a candidate Special Area of Conservation.

Historically, the saltmarsh in this area has been receding at a rate of 3 to 6m a year. BRANCH's modelling showed that by the 2080s, assuming that current defences are maintained, saltmarsh will be completely lost between Hurst and Lymington under all the climate change scenarios.

Managed realignment is often recognised as a management strategy to create intertidal habitats behind the sea defences. At this site, if the defences were realigned, land levels are too low relative to the tides for large areas of saltmarsh to become established. Realignment would, therefore, not compensate for the expected loss of saltmarshes locally. Designated coastal grazing marsh and saline lagoons would also be lost. Managed realignment would not be suitable in some parts of the study area due to the location of a landfill site and the town of Lymington.

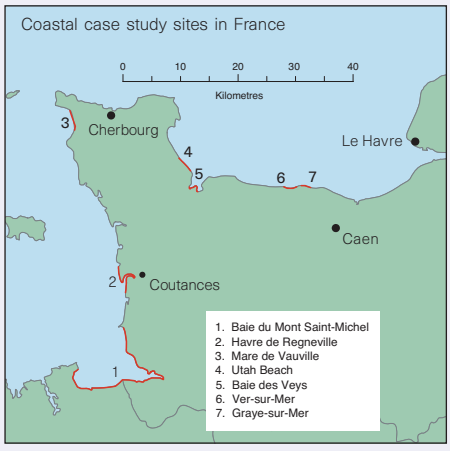
BRANCH has shown that sand dunes and mudflats on the Normandy coast are particularly vulnerable to rising sea levels. The project has developed tools to help stakeholders understand coastal sites and manage the effects of climate change.

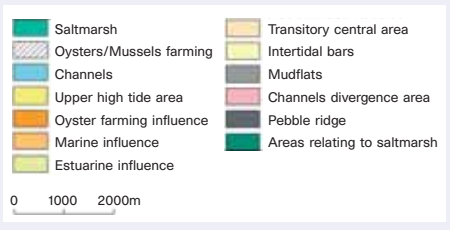
Managing change

Case study – The Normandy coast of France

BRANCH used seven case studies in Basse-Normandie to assess how climate change may affect coastal biodiversity. The study sites included sand dunes, saltmarsh, mudflats, grazing marsh and reed beds.

The study investigated the species and habitats of each site and their links with the geomorphology of the coast. It assessed how the estuary and dune areas were likely to change under rising sea levels and what risks each site might face. BRANCH recommended tools for planning, management and monitoring and discussed them with stakeholders.





OPPOSITE TOP: THE EXTENT OF COASTAL MUDFLATS, WHERE DUNLINS FEED, COULD DECREASE UNDER CLIMATE CHANGE IN FRANCE. JOHN MARTIN/NATURAL ENGLAND

OPPOSITE LEFT: BRANCH FOUND SAND DUNES WERE DECLINING AT ALL SEVEN STUDY SITES. CRT NORMANDY

OPPOSITE MIDDLE: LOCATIONS OF THE SEVEN CASE STUDY SITES ALONG THE NORMANDY COAST. NATURAL ENGLAND

OPPOSITE RIGHT: INTERTIDAL VEGETATION SURVEYS IN THE BAIE DES VEYS REVEALED SALTMARSH IS EXPANDING OUT INTO THE ESTUARY, REDUCING THE AREA AVAILABLE FOR MUDFLATS. GEMEL

Findings

BRANCH models show that mudflats, dunes, wetlands and freshwater ponds are the most vulnerable coastal habitats to climate change. Sand dunes are eroding on all the study sites. Dunes help to protect wetlands and freshwater ponds from salinization and flooding by the sea. Rises in sea level may make the erosion worse.

Saltmarshes are currently expanding at all the study sites, in contrast to the UK case studies, but this may be halted by sea-level rise. There are also high rates of sedimentation.

Long-term monitoring of coastal habitats, species and geomorphology will help stakeholders to better understand how the coast works and how it might change.

There are opportunities to protect intertidal habitats. Loss of habitat could be partly compensated by habitat re-creation through managed realignment. But this could lead to new conflicts between different protected habitats and with land use, particularly agriculture.

BRANCH provided guidance to help stakeholders manage and plan for climate change. This includes:

- Reports summarising current wildlife and coastal dynamics at case study sites and considering how these are likely to change in the future.
- A new flexible mapping tool for planners, to help evaluate land use decisions for the coast. This includes habitat and species datasets.

This mapping tool:

- Can show maps of vulnerability to sea-level rises of 50 and 100cm.
- Forms a baseline for a long-term monitoring program at the study sites.
- Takes into account current uncertainties of climate change impacts and will evolve to integrate developments in knowledge on extreme climate events.

The interest of Conseil Régional de Basse-Normandie and Agence de l'Eau Seine Normandie in the BRANCH project, which they co-financed, shows that French local stakeholders are seriously considering climate change.

Baie des Veys case study

The intertidal area in this protected estuary is almost 30 km^2. Saltmarshes were partly destroyed by land reclamation until 1972 and are now building up again, expanding onto the mudflats. The biodiversity of the intertidal area supports businesses, such as cockle harvesting and oyster farming.

The combination of sea-level rise, expanding saltmarsh and accumulating sediment in the estuary, may reduce the area available for mudflats. This would have major consequences for intertidal seabed invertebrates and for coastal waders. Higher sea levels and changes to the prevailing winds could also alter the coastal processes in the estuary.

In the polder du Carmel, sea defences were opened recently to create new intertidal habitat. There are now large areas of saltmarsh, many wading birds and an exceptionally rich population of crustaceans. This example shows that managed realignment can enhance coastal biodiversity and improve the resilience of the estuary to climate change.

Climate change will force many species to move and habitat composition will change. Some species will find it difficult to respond to climate change because the landscape in North West Europe is fragmented. But planners can help by creating new sites for wildlife in strategic locations and by improving ecological networks.

De-fragmenting the landscape

An overview of BRANCH's terrestrial case studies

BRANCH carried out three terrestrial case studies. In Hampshire and the South Downs (UK), partners investigated what opportunities there are for habitat creation and restoration to help species in chalk grassland and lowland heath cope better with climate change. In Limburg, Netherlands, partners tested how effective a planned wildlife corridor would be under a changing climate. Partners assessed the connectivity of the landscape (that is how easy it is for species to move across it) both with and without the corridor in place. In Kent (UK), BRANCH assessed the sustainability of existing habitat networks and developed a method for working with local stakeholders to design ecological networks for the future.

TOP: BEECH WOODLAND MAY STRUGGLE TO FOLLOW THE PACE OF ITS SHIFTING SUITABLE CLIMATE SPACE. STEPHEN DAVIS/NATURAL ENGLAND

FAR LEFT: BRANCH PARTNERS WORKED TOGETHER ACROSS EUROPE TO FIND BETTER SOLUTIONS FOR OUR TERRESTRIAL WILDLIFE. NATURAL ENGLAND

LEFT: BRANCH USED MODELS TO DISCOVER HOW BARRIERS MAY AFFECT SPECIES MOVEMENT WITHIN THE LANDSCAPE. KENT COUNTY COUNCIL/UKPERSPECTIVES.COM

Key findings

Species

Species will respond differently to a changing climate: in local areas some species are likely to decline or disappear, some will appear and several will remain. Species with the potential to move with favourable climate conditions into new areas may not find suitable habitats. Alternatively, they may not be able to colonise new suitable habitats because the landscape is too fragmented. Measures to improve connectivity and create new habitat will become increasingly important.

Planning for adaptation

Ecological networks consisting of large areas of well-connected, good quality habitat help wildlife to survive the effects of climate change. Retaining functioning habitat networks is important for species that are likely to decline under a changing climate. These networks will prolong the time that an area can sustain a species. For species moving into an area, it will be important to create "adaptation zones" that encourage colonisation of new suitable areas. These are zones where the existing habitat network is connected with neighbouring areas through which species can easily move.

The planned robust corridors, as in Limburg, can help wildlife adapt to climate change in the Netherlands. This may make the Dutch National Ecological Network better able to withstand the impacts of climate change.

Spatial planners need to make strategic choices to tackle climate change. The choices must take account of the differing responses of different species. The most effective regional strategies will then be those which integrate with strategies of neighbouring regions. Adaptation strategies should be monitored for their effectiveness.

Working with stakeholders

BRANCH developed a method for working with local stakeholders to design climate-proof ecological networks, using local expertise. This approach was useful but needs to be simplified. It helps to prioritise which habitats and species need adaptation strategies and how these can be developed. It can also provide evidence to support decision-making where there are competing priorities.

Recommendations

Adaptation strategies

- Improve existing and create new, well-connected habitat networks for wildlife in strategic locations.
- Monitor the effectiveness of existing ecological networks in helping species and habitats to adapt to climate change. Refine the networks if necessary.
- Link adaptation strategies for biodiversity to strategies for other land uses affected by climate change, such as flood prevention.
- Adapt site management techniques to improve habitat quality. This may help populations survive in a less favourable climate.

Policy

- Accept that traditional species in an area may decline and new species may move in. Provide connected habitats for the benefit of both expanding and declining species.
- Identify areas where species may arrive and leave a plan area and create 'adaptation zones' to facilitate species movement.
- Ensure decisions on adaptation actions are made across national and regional borders.
- Ensure policy is flexible, integrated and long-term. Monitor the effectiveness of adaptation strategies and refine if necessary.

BRANCH found that the lowland heath and chalk grassland of Hampshire could disappear or change significantly in composition because of climate change. Species found in these habitats will react differently to climate change over time. The best long-term solution may be to use a range of management techniques to create new variety within designated sites, so facilitating species movement.

Changing habitats

Case study: Hampshire and the South Downs, UK

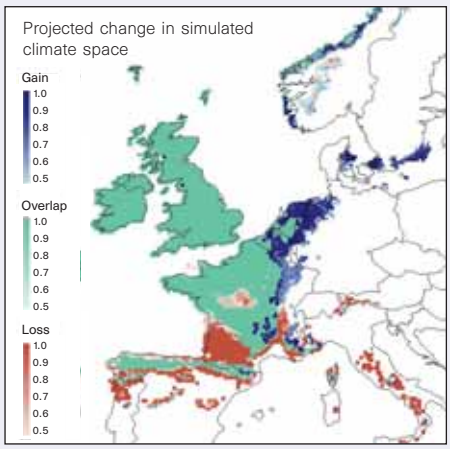
Chalk grassland and lowland heath

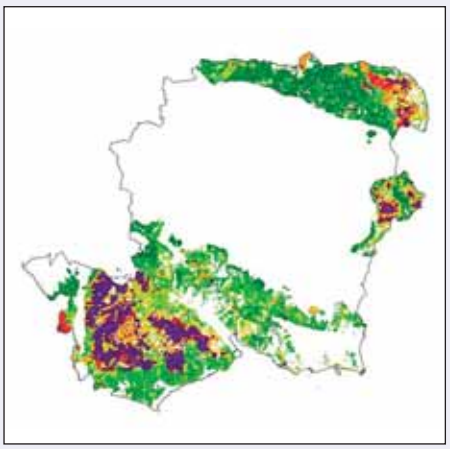
Chalk grassland and lowland heath are two important and characteristic habitats of Hampshire and the South Downs. BRANCH looked at how climate change might affect them during the 21st century. Partners also considered what measures might be available to help the species of these habitats adapt to climate change.

Partners used the SPECIES model to project changes in potential climate space (the geographical area where climate conditions are suitable) for a range of species chosen to represent lowland heath and chalk grassland habitats. We produced maps to show where there could be climate space for these species, both nationally and in Hampshire, under climate change scenarios for the 2020s, 2050s and 2080s.

The potential climate space for each species was compared with their current habitat distribution and with places where opportunities for habitat creation and restoration had been previously mapped (by Hampshire Biodiversity Information Centre). Partners then discussed the implications with local planners and ecologists.

This information will help spatial planners meet their commitments to the UK and local Biodiversity Action Plans and the regional spatial strategy.





Existing heath and acid grassland

Habitat suitability index

1.806 - 3.480	5.809 - 6.530
3.481 - 4.279	6.531 - 7.132
4.820 - 5.025	7.133 - 7.720
5.026 - 5.808	7.721 - 9.000

Findings

Lowland heath and chalk grassland species are likely to respond to climate change differently. They could gain and lose climate space in varying amounts. The response of these species to climate change is also likely to change over time. Some could find new climate space in the short and medium term. But they could have no climate space under the 2080s high emissions scenario of climate change. Some may disappear unless they can adapt to new conditions.

Species that still have climate space by the 2080s may still suffer because other species on which they rely have disappeared. For example, just four lowland heath species (wavy hair grass, sheep's sorrel, Dartford warbler, and silver-studded blue butterfly) are likely to retain suitable climate space in Hampshire. But even their stability could be threatened by the loss of other important species upon which they rely.

New species assemblages may be seen. Lowland heath in the county could change significantly in composition because the key ericaceous (acid-loving) species are projected to lose all or nearly all their potential climate space in the 2080s scenario. The composition of chalk grassland may also change as it loses important species, including grasses, and gains others.

Habitat re-creation could help species expand into new climate space. But with the projected total loss of climate space for some key species this may not be enough to save the habitat type as we know it. Creating variety within the habitats of existing designated sites to accommodate changing species assemblages, may be the best long-term adaptation option.

OPPOSITE LEFT: WILD THYME WAS ONE OF 12 LOWLAND HEATH SPECIES MODELLED. NATURAL ENGLAND

OPPOSITE MIDDLE: A PROJECTION OF POTENTIAL SUITABLE CLIMATE SPACE AT THE EUROPEAN SCALE FOR WILD THYME USING HADCM3A2 FOR 2050s. ECI

OPPOSITE RIGHT: A GIS MODEL OUTPUT FOR HAMPSHIRE, IDENTIFYING POTENTIAL SUITABILITY OF LAND FOR THE RESTORATION AND RE-CREATION OF LOWLAND HEATH. THE HIGHER THE SUITABILITY INDEX NUMBER THE GREATER THE 'OPPORTUNITY' FOR HEATH HABITAT TO ESTABLISH. PURPLE INDICATES EXISTING HEATHLAND HABITAT. ANDY FOY/HAMPSHIRE COUNTY COUNCIL. ©CROWN COPYRIGHT

RIGHT: SOME KEY LOWLAND HEATH SPECIES MAY LOSE NEARLY ALL POTENTIAL SUITABLE CLIMATE SPACE BY THE 2080s. THE NEW FOREST (UK). NATURAL ENGLAND

The robust corridor in Limburg – habitat creation planned near the Dutch border with Germany – should enable wildlife to adapt to climate change. BRANCH showed that species are likely to move through the corridor to follow suitable climate conditions. To be as effective as possible, the creation of the corridor has to be a co-operative effort between Dutch and German planners.

Testing the corridor

Case Study: Limburg, The Netherlands

This study tested the effectiveness of a robust corridor being created in the southern Dutch province of Limburg as part of the Dutch National Ecological Network. The corridor links a chain of habitats on the eastern bank of the river Maas, on both sides of the Dutch-German border.

The corridor will eventually run from Schinveld to the Reichswald and contains over 2200 ha of planned habitat creation. It is intended to improve links between habitat patches in the Dutch National Ecological Network and the Natura 2000 network along both sides of the border. Important habitats in the Network are forests, heathland, pasture, hedges, arable fields and marshy valleys.

Partners carried out vegetation and breeding bird surveys and created habitat maps for Limburg province and the neighbouring part of Germany. The SMALLSTEPS model was used to analyse how freely wildlife could move between habitats. Finally, partners used the LARCH model to produce maps that showed how climate change could improve or reduce the sustainability of the habitat networks of selected species, with and without the robust corridor.

Species which were modelled included: sand lizard; purple emperor butterfly; great crested newt; Dartford warbler; Cetti's warbler; woodlark and Bechstein's bat. These species have different dispersal capacities and are likely to respond differently to climate change.

The example of the sand lizard

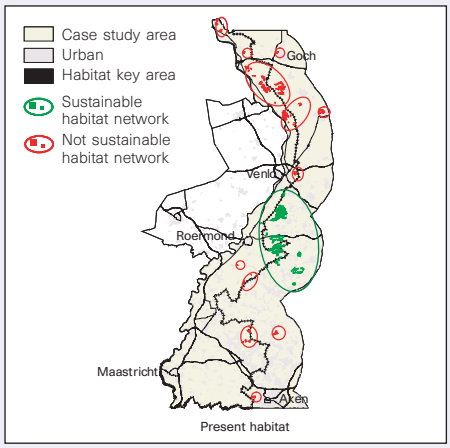
The sand lizard lives on heathland in Limburg. The SPECIES model indicated that it is likely to become a declining species during the latter part of this century as it loses suitable climate space. The SMALLSTEPS model showed that the sand lizard's habitat would probably become increasingly isolated. However, the creation of new habitat planned in the robust corridor is likely to prevent this to a large extent. Even though the climate is likely to become less suitable, the new habitat should support sustainable populations of the sand lizard and enable it to survive in Limburg for longer.

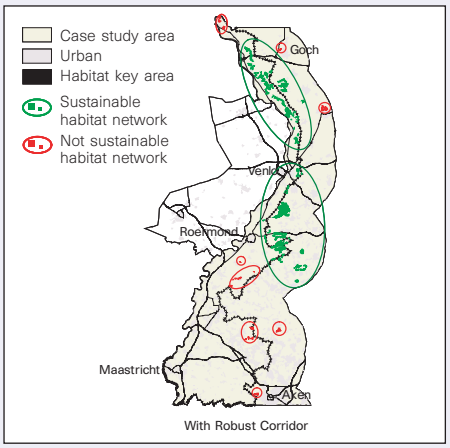
Findings

The development of robust corridors is likely to help most species follow the movement of their suitable climate space, into and through the Dutch National Ecological Network and the Natura 2000 sites along the Dutch-German border. For some species, moving easily across the landscape may still be a challenge. This could be solved by creating new habitat. In addition, the robust corridor may enable species like the sand lizard, losing suitable climate space, to survive in the area for longer.

Modelling results show that the robust corridor is most effective for ground-living and small flying species. It is less important for larger birds because they do not have a problem covering this sort of distance.

The design of robust corridors should focus on the species they are intended to help. Key factors to consider are: the dispersal capacity of a species and its potential distribution in a changing climate. The effects of a corridor should be monitored and the design changed where necessary.





OPPOSITE LEFT: THE SAND LIZARD COULD LOSE SOME SUITABLE CLIMATE SPACE IN NORTH WEST EUROPE BY THE END OF THIS CENTURY. SARAH GARDINER

OPPOSITE RIGHT: PARTNERS HAVE PRODUCED TOOLS, SURVEYS AND DATA TO HELP PLANNERS. PROVINCIE LIMBURG

ABOVE LEFT: WORKING ACROSS NATIONAL BORDERS HAS INCREASED SPACE FOR NATURE ON BOTH SIDES OF THE DUTCH-GERMAN BORDER. IMAGESOFHOLLAND.COM

ABOVE MIDDLE: SUSTAINABLE HABITAT NETWORKS FOR THE SAND LIZARD IN LIMBURG, WHEN CLIMATE STRESS IS ASSUMED, MODELLED WITHOUT THE ROBUST CORRIDOR IN PLACE. ALTERRA

ABOVE RIGHT: THE ADDED HABITAT CREATED IN THE ROBUST CORRIDOR PLAN IMPROVES THE SUSTAINABILITY OF THE NETWORK FOR THE SAND LIZARD UNDER CLIMATE STRESS. ALTERRA

Creating a landscape that can withstand the effects of climate change will help biodiversity adapt. BRANCH worked with stakeholders in Kent to develop a transferable method to design climate change-proof ecological networks.

Natural landscape design

Case Study: Kent, UK

BRANCH examined how a group of species, chosen with local stakeholders to represent different characteristic habitats in Kent, may respond to climate change. Partners assessed the sustainability of habitat networks and how well they are linked. They also developed a method for local stakeholders to design ecological networks as a climate change adaptation strategy. This identifies strategic locations where well-linked habitat networks could be improved or created.

Designing networks with stakeholders

Stakeholder engagement is crucial to network design. Habitat maps for the selected species were produced by the local Biological Records Centre. The SPECIES model indicated which species were likely to decline or disappear, or to appear or remain. The SMALLSTEPS model was then used to analyse how freely wildlife could move between habitats and the LARCH model assessed the sustainability of present and future habitat networks. BRANCH then used this modelling and local expertise to identify bottlenecks and investigate how to design well-connected, climate-proof networks.

The design method was used at a stakeholder workshop. The method consists of four steps:

1. Choosing indicator species for characteristic Kent habitats
2. Identifying important habitat networks and suggesting local constraints and opportunities for habitat creation
3. Producing alternative options for improving and creating habitat networks
4. Deciding the best option for each habitat and integrating these into an ecological network design for Kent.

Species within the same habitat may react differently to climate change. One group, including the great crested newt and meadow pipit, is likely to decline with climate change. Another group, such as the Dartford warbler and Bechstein's bat is likely to be able to expand in the County.

The example of the Adonis blue

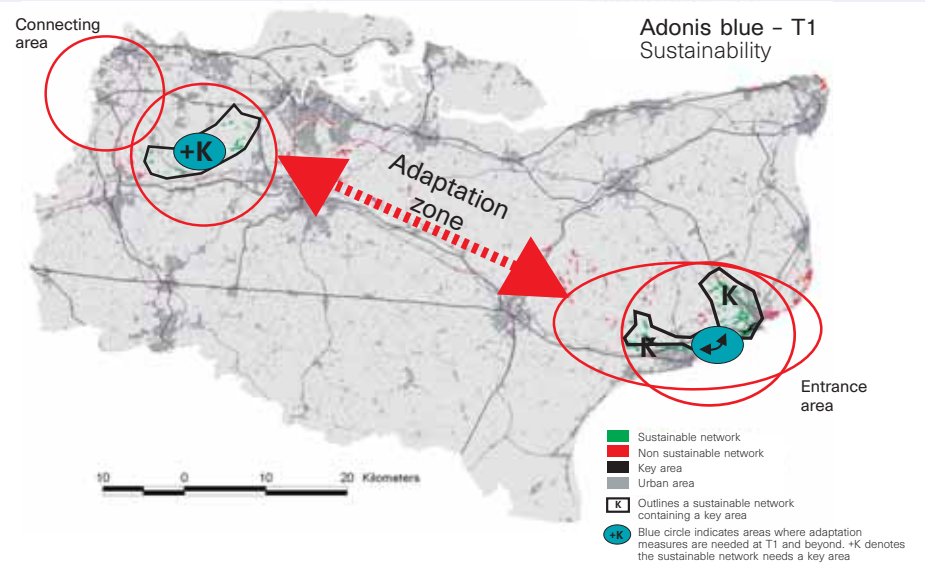
The Adonis blue butterfly was chosen to represent chalk grassland species. The SPECIES model showed that the climate in Kent is likely to become more favourable for this species. The SMALLSTEPS model showed that the present habitat is isolated in several unconnected networks. Partners identified constraints in the landscape and also adaptation zones - the shortest distances between key areas for the Adonis blue. Working with stakeholders, partners used this information to design a landscape that would help the butterfly, and other chalk grassland species with similar dispersal capabilities, adapt to climate change.

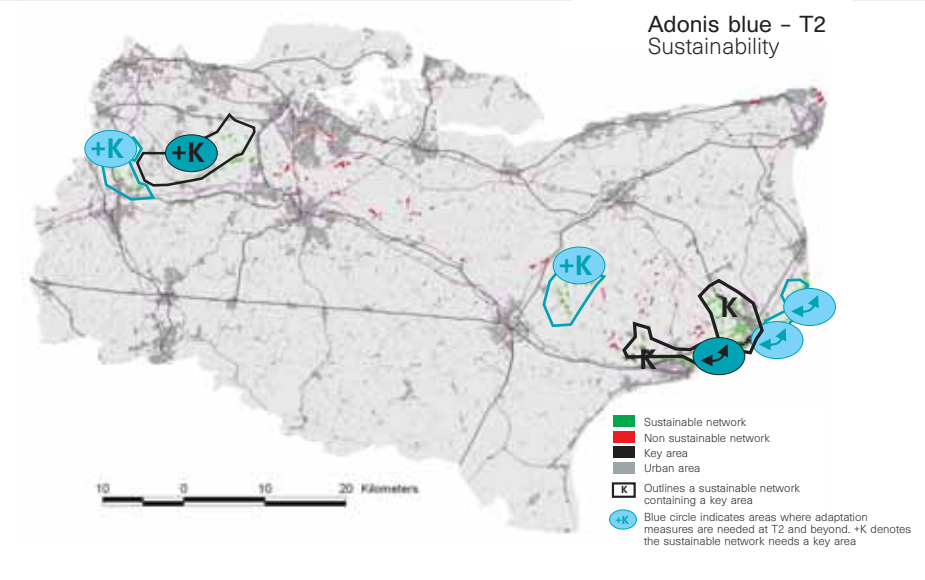
Findings

BRANCH modelling showed that Kent's habitats are not sufficiently connected at present to allow some species to adapt to climate change. Ecological networks, such as those developed using the BRANCH design process, are likely to help wildlife adapt. They can be accommodated in the planning process and planners and local stakeholders can collaborate on their design. The involvement of stakeholders will be vital to the ongoing design, success and implementation of the Kent network.

The design method takes different strategies for species that are likely to leave an area because of climate change and those that are likely to move into an area. For species where the climate becomes less suitable, planners should concentrate on maintaining sustainable networks, because these prolong the time species can remain locally.

For species where the climate becomes more suitable, planners should aim to maximise colonisation. They should concentrate on adaptation zones that have large areas of suitable habitat and aim to improve connectivity so that species can disperse easily.





OPPOSITE LEFT: ADONIS BLUE A CHALK GRASSLAND SPECIES THAT CAN GAIN SUITABLE CLIMATE SPACE IN NORTH WEST EUROPE UNDER CLIMATE CHANGE. NATURAL ENGLAND

OPPOSITE RIGHT: BRANCH WORKED WITH STAKEHOLDERS IN KENT TO IDENTIFY IMPORTANT HABITAT NETWORKS AND LOCAL BARRIERS. ALTERRA

LEFT: DESIGNING OPTIONS FOR ADAPTATION STRATEGIES. T1 AND T2 RELATE TO DIFFERENT POINTS IN TIME. T1 SHOWS THE POTENTIAL SUSTAINABILITY OF THE HABITAT NETWORK FOR THE ADONIS BLUE WHEN CARRYING CAPACITY OF THE HABITAT IS LOW AS A RESULT OF A MARGINAL SUITABLE CLIMATE (ONLY 10% OF CARRYING CAPACITY IN OPTIMAL CLIMATE CONDITIONS, SIMILAR TO THE PRESENT CLIMATE SITUATION); T2 SHOWS THE POTENTIAL SUSTAINABILITY OF THE HABITAT NETWORK FOR THE ADONIS BLUE UNDER IMPROVED CLIMATE CONDITIONS (20% OF CARRYING CAPACITY IN OPTIMAL CLIMATE CONDITIONS). AS THE CLIMATE BECOMES MORE SUITABLE AND SPECIES DENSITIES RISE, THE CONNECTIVITY OF HABITAT PATCHES INCREASES AND MORE PATCHES MAY JOIN THE HABITAT NETWORK. THE MAPS HELP TO IDENTIFY KEY AREAS TO TARGET ADAPTATION.

Spatial planning should encourage measures that enable species and habitats to adapt to climate change. Some existing policies could be useful if they were implemented. But the present system has serious limitations and new approaches are needed.

Conclusions

The risk of climate change

Modelling has demonstrated the challenge that faces wildlife in adapting to climate change in the highly fragmented region of North West Europe. Coastal habitats are predicted to decline under sea-level rises. This problem will be compounded where hard sea defences prevent intertidal habitat moving inland.

Spatial planning is vital

Spatial planning can create the conditions for biodiversity to adapt to climate change. Planners have a crucial role in creating opportunities for habitat restoration and in reducing the costly deterioration of Europe's natural environment. BRANCH's work with planners has shown that the present spatial planning system has significant limitations. Case studies demonstrate how past land use planning decisions limit options for adaptation.

Integrated approach and communication

In future, an integrated approach to spatial planning could enable wildlife to adapt to a changing climate. Longer planning horizons, greater integration between sectors and more flexible use of land over time can help achieve this. Planners have told BRANCH that the low profile of biodiversity is still limiting action. It is important to make the case that the natural environment provides vital goods and services to society. Using existing policies that provide some support for adaptation can ensure that adaptation measures are implemented. Monitoring the effectiveness of adaptation strategies can inform the further refinement of policies.

Leadership and co-operation

A European and national spatial vision for biodiversity would provide the leadership needed to plan for biodiversity as the climate changes. The Dutch National Ecological Network and its robust corridors, is an example of such a spatial plan that protects and enhances national wildlife. Co-operation is needed across national borders and planners need to co-ordinate their work across boundaries. This will be a challenge for EU Member States because they often have different approaches to habitat creation and restoration.

Wildlife networks

Europe needs a network of wildlife sites that function together and a landscape that allows species to respond dynamically to climate change by moving to new areas. BRANCH modelling has demonstrated that

OPPOSITE LEFT: THE IMPACTS OF CLIMATE CHANGE SUCH AS FLOODING, ARE ALREADY BEING FELT WITH INCREASING TEMPERATURES AND CHANGES IN RAINFALL. NATURAL ENGLAND

OPPOSITE MIDDLE: HEALTHY NATURAL SYSTEMS PROVIDE SIGNIFICANT BENEFITS TO PEOPLE. NATURAL ENGLAND

OPPOSITE RIGHT: A DUTCH 'GREEN BRIDGE' OVER TRANSPORT LINKS AT CRAILO – AN ENGINEERING SOLUTION TO THE PROBLEM OF FRAGMENTED HABITATS. NATURAL ENGLAND

BELOW LEFT: BRANCH PARTNERS HAVE WORKED TOGETHER ACROSS NATIONAL BORDERS TO PRODUCE TOOLS TO ASSIST PLANNERS. NATURAL ENGLAND

BELOW MIDDLE: BRANCH'S MULTI-SECTOR PARTNERSHIP HAS PRODUCED A UNIQUE TRANSFERABLE EVIDENCE BASE. COASTAL VISUALISATION. TYNDALL CENTRE

BELOW RIGHT: EUROPE NEEDS LANDSCAPES THAT ALLOW SPECIES, SUCH AS THE RED SQUIRREL, TO RESPOND DYNAMICALLY TO CLIMATE CHANGE. CHRIS WEDGE/NATURAL ENGLAND

larger sites become increasingly important as climate conditions become less suitable. Compared with small isolated areas, large sites provide conditions that sustain declining species for longer. They are also a source of individual species looking to colonise new, more suitable areas.

Reinterpreting the Habitats Directive

BRANCH demonstrated that Natura 2000 sites need to be developed into a coherent ecological network that protects wildlife and encourages resilience. It could increase wildlife's capacity to endure the disturbance of climate change. If reinterpreted, the provisions of the EC Habitats Directive for site protection could achieve this. Additionally, full implementation of Article 10, which is intended to improve connectivity, would help link sites into and create this network.

Flexible responses

BRANCH demonstrated the challenges at the coast where there is often limited space to re-create habitats lost as a result of sea-level rise. Wildlife will benefit if existing legislation, such as the Habitats Directive, incorporates a more flexible response to changes at protected sites. Strategic decisions are needed to secure the future of habitats within designated sites for as long as possible. This may mean re-creating some habitats in different places. It could mean designating rolling or moveable site boundaries. Where space is very limited, planners may need to look for land for habitat creation in different regions or even different countries.

Transferable tools

Through working together and engaging stakeholders and experts, BRANCH partners have developed adaptation strategies and tools which are transferable throughout Europe and beyond. This multi-disciplinary and transnational approach has built a unique evidence base.

Act now

BRANCH evidence confirms that there is an urgent need for spatial planners to act now to ensure that wildlife can respond to climate change. Legislation and planning guidance should be improved. BRANCH has demonstrated that the implementation of existing biodiversity policies could start de-fragmenting the landscape. This will help ensure that our countries support thriving populations of species both now and in the future.

BRANCH has shown that planning for biodiversity in a changing climate is needed at all policy levels. European and national legislation should provide leadership and vision. Regional and local plans should set land use policies that will enable wildlife to adapt to the long-term impacts of climate change.

Recommendations

Five recommendations for European policy leadership

1. Produce a vision for Europe's biodiversity which provides wildlife with future space to adapt to climate change. This would set the direction that planners and practitioners need.
2. Reinterpret the EC Habitats Directive so that it can be implemented flexibly to protect wildlife in Natura 2000 sites. In future, the Directive should:
   - Allow, where necessary, protected wildlife in a site to change over time while ensuring these species or habitats are retained elsewhere in the Natura 2000 network, by encouraging co-operation between EU Member States.
   - Establish rolling, variable boundaries for mobile sites, for example, on eroding coasts.
3. Increase connectivity between Natura 2000 sites making it easier for species to move. This should be achieved by implementing Article 10 of the Habitats Directive. BRANCH has shown that increased connectivity will enable wildlife to respond more resiliently to climate change.
4. Promote collaboration between different sectors involved in land use planning. Biodiversity will not be able to adapt to climate change if it is restricted to isolated protected sites. Agriculture, coastal and flood protection and well-planned infrastructure developments could benefit biodiversity by promoting (and not impeding) connectivity.
5. Integrate climate change into European Directives such as the Strategic Environmental Assessment, Environmental Impact Assessment and Water Framework Directives. This would provide guidance and encourage plans and projects to incorporate adaptation to the impacts of climate change. It would also give guidance to planners and support for adaptation policies.

THE LONG-TERM IMPACTS OF CLIMATE CHANGE NEED TO BE CONSIDERED IN PLANNING DECISIONS MADE NOW. DAVID SMALLSHIRE/NATURAL ENGLAND

BRANCH'S OUTPUTS WERE SHAPED BY STAKEHOLDER DISCUSSIONS AT OVER 30 EVENTS. GREENWEEK 2006. SIMON JUDE

PLANNERS NEED HIGH-LEVEL LEADERSHIP AND VISION TO ASSIST INTEGRATION OF CLIMATE CHANGE INTO PLANS AND POLICY. THE EUROPEAN PARLIAMENT. DAN LAFFOLEY/NATURAL ENGLAND

Five recommendations for national spatial planning and policy guidance

1. Change the spatial planning system to ensure that planners can take account of the long-term effects of their decisions. BRANCH found that planners do not currently have the support or tools to consider longer timescales. Adaptation to the impacts of climate change should not be constrained by short-term decision-making.

2. Allow land to be set aside for future use by wildlife. This could be achieved by spatial planning policies or mechanisms such as co-ordinated land banking. This is particularly urgent at the coast where a strategic overview is needed to ensure that coastal habitats have space to move inland as sea-levels rise.

3. Use fiscal and legal incentives to encourage different sectors to implement adaptation policies. The BRANCH policy review showed that the current approach often depends on partnerships and is slow to produce results.

4. Promote a national spatial vision for biodiversity in a changing climate in England and France. This should encourage a network of well-managed designated sites connected across a wildlife-friendly wider countryside. The vision would give stakeholders the leadership they need. In the Netherlands, test the National Ecological Network, using BRANCH's Limburg example, against the potential impacts of climate change. Revise the Network if necessary.

5. Co-operate between sectors and across administrative boundaries, including with other EU Member States, to implement adaptation measures for wildlife. Ensure there is also integration between different planning levels.

Five recommendations for regional and local spatial planners

1. Raise awareness of the benefits of the natural environment to society. Show how spatial planning can create, support and maintain healthy ecosystems. This is a first step to help increase wildlife's resilience to climate change.

2. Use policies in spatial plans to create a landscape that enables wildlife to adapt to climate change. This means establishing larger and richer habitat areas that are better connected. It also means avoiding planning decisions which fragment areas with habitat value. (See also Page 26)

3. Identify strategically important places where habitats can be created to offset losses caused by climate change. These locations should be safeguarded from development by policies in regional and local plans. BRANCH has shown that unless this happens, habitats will become increasingly vulnerable and unable to adapt to climate change.

4. Inform decision-making with an evidence base that includes policy recommendations, visualisations and planning tools. BRANCH has produced transferable materials, training and techniques that can help.

5. Ensure adequate, consistent long-term datasets are available. BRANCH has shown that a lack of good data, especially across administrative boundaries, makes decision-making difficult. Policy making must also be informed by reviewing the actual impacts of climate change and monitoring the effectiveness of adaptation measures.

Actions that spatial planners can take now

Ensure your **plans** include objectives that encourage **biodiversity adaptation to climate change**. Monitor delivery of these using targets and indicators and use plan reviews to amend accordingly.

Include the impacts of climate change on wildlife in your **Sustainability Appraisals, Strategic Environmental Assessments, Environmental Impact Assessments** and **Appropriate Assessments**.

Consider what impacts planning decisions made now will have in the **longer term** under a changing climate. Are you foreclosing future options for adaptation?

Consider the **wider context** of your area when writing policy. What would prevent wildlife moving in response to climate change? Where might species enter your plan area and from where might they leave? Are there bottlenecks impeding movement?

Consider the actions that you can take to benefit wildlife **now and as climate changes**. These include:

- Protecting, enhancing, enlarging and connecting **existing nature areas**.
- Planning **ecological networks**, through a partnership of spatial planners, wildlife experts and other stakeholders, such as water planners.
- **Prioritising** and **safeguarding** areas for strategic habitat creation, including coastal realignment.
- **Avoiding** planning decisions that lead to habitat **fragmentation**.
- Promoting policies that **benefit wildlife**, as well as other sectors. This might include providing green infrastructure that also improves the connectivity of habitat in the landscape.
- Encouraging, where possible, the **creation** and long-term management of habitats by, for example, using developers' contributions.

Consider incorporating policies that encourage the **flexible use of land**, including safeguarding areas for biodiversity, over different timescales.

Implement policies designed to help biodiversity adapt to climate change, and monitor their effectiveness.

Raise awareness among fellow planners and others by using BRANCH training materials, case studies, adaptation strategies and techniques.

BELOW LEFT: ACTION IS NEEDED NOW TO ALLOW SPACE FOR WILDLIFE TO ADAPT TO A CHANGING CLIMATE. ONE WAY TO DO THIS IS THROUGH OUR SPATIAL PLANNING SYSTEM. RUTH HAYHURST COMMUNICATIONS

BELOW MIDDLE: THE PARTNERSHIP HAS ENGAGED WITH OVER 1000 STAKEHOLDERS AT OVER 30 EVENTS. BUILDING PRACTITIONERS' CAPACITY TO TAKE ACTION. NATURAL ENGLAND

BELOW RIGHT: OUR NATURAL SYSTEMS NEED HELP TO PREPARE FOR THE RISKS AND OPPORTUNITIES CLIMATE CHANGE BRINGS. NATURAL ENGLAND

Supporting evidence

Full reports included as annexes on CD

Delivering results

This summary report and recommendations are supported by a range of modelling results, case studies, policy analysis, stakeholder discussions and transferable tools developed by BRANCH. These have been produced by the project's working groups and are presented in detailed reports on the annexed CD.

Policy review – Annex 1

A review of spatial planning policies now being used to protect and enhance biodiversity under a changing climate. The review assessed EU and national policies as well as planning documents at various levels, across England, France and the Netherlands. It includes examples of measures available to help build biodiversity resilience and recommendations for policy and practical action.

Biodiversity's response – Annex 2

An assessment of the vulnerability of terrestrial and coastal habitats and species in Europe to climate change. Many of this study's outputs were used to inform other areas of project research. The report includes the development of transferable methodologies for identifying areas vulnerable to climate change and begins to identify strategies for adaptation for specified habitats and species, within the context of spatial planning.

Vulnerable coasts – Annex 3

A report on the methods and approaches used to assess the impact of sea-level rises on coasts, at scales from European to local case study. It presents analysis of extensive survey and modelling results and details how final outputs were developed through a programme of stakeholder consultation. These include a tool for assessing the impact of policy and planning decisions in relation to climate change and coastal ecosystems.

Permeable landscapes – Annex 4

An analysis of the impacts of climate change on biodiversity in terrestrial case studies. This report details research approaches and modelling results, focusing on the development and strengthening of ecological networks. It discusses the policy implications of these findings and adaptation strategies for planners.

Influencing improvements – Annex 5

A report on workshops for planners designed to increase understanding of practical actions planners can take to facilitate wildlife adaptation to climate change. It provides guidance to enable partnerships and authorities to run their own workshops.

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Annexes

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BIODIVERSITY
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CLIMATE CHANGE

This project has received European Regional Development Funding through the INTERREG III B Community Initiative

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INTERREG IIIB
NORTH WEST EUROPE

Planning for biodiversity as climate changes

BRANCH project final report

Annexes

Biodiversity must adapt to climate change. For many habitats and species, this will be difficult because the landscape across Europe is fragmented and past decisions limit the opportunities for adaptation. Spatial planners must act now to create a landscape and coastline that can withstand the effects of climate change. BRANCH provides the guidance and evidence to take action.

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